

Claims:

1. A probe for detecting a highly ordered structural site of a nucleic acid of a gene by specifically binding with the structural site to generate an electrochemical response, the probe comprising a cyclic ligand containing ferrocenyl group and a DNA threading intercalating moiety.

2. The probe as claimed in claim 1, wherein the cyclic ligand further comprises two linker moiety each having two terminal amino groups, each linker moiety is connected with the DNA threading intercalating moiety through one of its terminal amino groups, and each linker moiety is connected with the ferrocenyl group through the other of its terminal amino groups.

3. The probe as claimed in claim 2, wherein the linker moiety is a residual group of an amine having the terminal amino groups.

4. The probe as claimed in claim 3, wherein the amine comprises another amino group, and two alkyl groups each bonded with each terminal amino group and bonded with another amino group.

5. The probe as claimed in claim 4, wherein the another amino group is piperazinyl group.

6. The probe as claimed in claim 4, wherein the alkyl group has 1 to 6 carbon atoms.

7. The probe as claimed in claim 6, wherein the alkyl group is selected from a group consisting of ethyl group and propyl group.

8. The probe as claimed in claim 3, wherein the amine is selected from a group consisting of 1,4-bis(3-aminopropyl)piperazine, 1,1'-bis(3-aminopropyl)methylamine, 1,1'-bis(2-aminoethyl)amine, 1,1'-bis(3-aminopropyl)amine, spermine and spermidine.

9. The probe as claimed in claim 2, wherein the DNA threading

intercalating moiety comprises an aromatic group selected from a group consisting of 1, 4, 5, 8-tetrasubstituted naphthalene, 9, 10-disubstituted anthracene, and 1, 5-disubstituted anthraquinone.

10. The probe as claimed in claim 9, wherein the aromatic group is 1, 4, 5, 8-tetrasubstituted naphthalene.

11. The probe as claimed in claim 9 or 10, wherein the DNA threading intercalating moiety further comprises carbonyl groups, iminomethylene groups, or thiocarbonyl groups, through which the DNA threading intercalating moiety is bonded with the terminal amino groups.

12. The probe as claimed in claim 1, wherein the structural site is a high-order structure in a DNA or RNA.

13. The probe as claimed in claim 1, wherein the structural site is selected from a group consisting of a mismatch structure in an oncogenic DNA, a hairpin structure of a viral RNA and a bulge structure.

14. A method for detecting a highly ordered structural site of a nucleic acid of a gene, the method comprising:

contacting a gene with the probe as claimed in claim 1 or 2 to generate an electrochemical response; and
detecting the electrochemical response.

15. A device for detecting a highly ordered structural site of a nucleic acid of a gene using the probe as claimed in claim 1 or 2, the device comprising:

a container,
a solution for dissolving the probe, the solution being held in the container,
a working electrode modified with a gene, the working electrode dipped in the solution in the container, and
a counter electrode dipped in the solution in the container.